

Tolerancing of diffraction-limited Kirkpatrick-Baez synchrotron beamline optics for EUV metrology

Patrick P. Naulleau, Kenneth A. Goldberg, Phillip J. Batson, Seongtae Jeong,
and James H. Underwood

Center for X-Ray Optics
Lawrence Berkeley National Laboratory
Berkeley, CA 94720

Abstract: The recent interest in extreme ultraviolet (EUV) lithography has led to the development of an array of at-wavelength metrologies implemented on synchrotron beamlines. These beamlines commonly use Kirkpatrick-Baez systems consisting of two perpendicular, elliptically-bent mirrors in series. To achieve high-efficiency focusing into a small spot, unprecedented fabrication and assembly tolerance is required of these systems. Here we present a detailed error-budget analysis and develop a set of specifications for diffraction-limited performance for the Kirkpatrick-Baez optic operating on the EUV interferometry beamline at Lawrence Berkeley National Laboratory's Advanced Light Source. The specifications are based on CODE V modeling tools developed explicitly for these optical systems. Although developed for one particular system, the alignment sensitivities presented here are relevant to Kirkpatrick-Baez system designs in general.

OCIS Codes: 340.6720, 220.2740, 220.4830, 220.1010, 220.1140

	M5	M6
Tilt	$\pm 0.0046^\circ$	$\pm 0.0054^\circ$
Roll	$\pm 0.025^\circ$	$\pm 0.046^\circ$
Yaw	$\pm 0.44^\circ$	$\pm 0.86^\circ$

Table 1. Rotation error tolerances for M5 and M6. Rotations are made about the centers of the mirrors. The axes are defined as shown in Figure 4. Tolerances are defined as those errors that cause a doubling in the width of the point spread function.

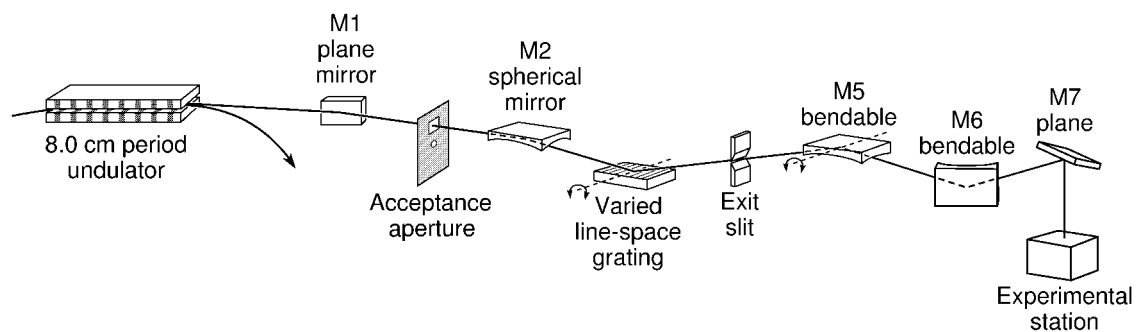


Fig. 1. Schematic of the EUV interferometry beamline at the Advanced Light Source synchrotron radiation facility at Lawrence Berkeley National Laboratory. This beamline produces a demagnified image of the undulator source at the focal plane of the K-B, corresponding to the entrance plane of the experimental station.